

THE AUSTRALIAN FROG *CHIROLEPTES DAHLII* BOULENGER: ITS SYSTEMATIC POSITION, MORPHOLOGY, CHROMOSOMES AND DISTRIBUTION

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Summary

TYLER, M. J., DAVIES, M. & KING, M. (1978) The Australian frog *Chiroleptes dahliei* Boulenger: its systematic position, morphology, chromosomes and distribution. *Trans. R. Soc. S. Aust.* **102**(1), 17-23, 28 February, 1978.

The external morphology, osteology and karyotype of *Chiroleptes dahliei* demonstrate that this species is erroneously referred to the Leptodactylidae and is in reality a hylid related to the southeastern Australian species, *Litoria raniformis*.

Introduction

The Australian frog *Chiroleptes dahliei* Boulenger (1895) was based on two specimens taken at Daly River, Northern Territory by Dahl. Despite its comparatively large size (up to 85 mm snout to vent length) this species has been reported only rarely, so that little is known of its morphology, and nothing of its biology and close phylogenetic relationships. In referring it to the genus *Cyclorana* Steindachner, H. W. Parker (1940) had access to only one specimen: a syntype.

The second published report of the species appears to be that of Tyler (1969) who identified as *C. dahliei* frogs from Knuckey's Lagoon near Darwin, previously reported as *Hyla aurea* by Loveridge (1949). The only additional published record of *C. dahliei* is one of its collection at Edward River in Queensland by F. Parker & Tanner (1971).

Through the assistance of Mr G. Miles we have received and maintained in our laboratory a series of *C. dahliei* from localities near Darwin. The striking superficial resemblance of these frogs to *Litoria raniformis* (Kesterstein), familiar to us from South Australia, caused us to examine the systematic position of *dahliei*.

Material and methods

Data on external morphology reported here are derived principally from specimens deposited

in various museum collections abbreviated in the text as follows:

Museum of Comparative Zoology, Harvard University (MCZ)

Northern Territory Museum, Alice Springs (NTM)

South Australian Museum, Adelaide (SAM)

Western Australian Museum, Perth (WAM)

Osteological details of *dahliei* were obtained from a series taken at Beaufort Hill near Darwin. Those from *L. raniformis* were from the southeast of South Australia. These preparations are housed in the University of Adelaide, Department of Zoology.

Karyological data were obtained from specimens of *dahliei* from Beaufort Hill and Cannon Hill, and of *L. raniformis* from Mil Lel, S.A., Renmark, S.A. and Interlaken, Tasmania. Mitotic chromosomes were obtained from intestinal epithelial cells using an air dried technique described by King & Rofe (1976).

Methods of measurements of external features follow those described by Tyler (1968), whilst skull measurements and descriptive terminology follow the pattern adopted by Davies (1978).

Systematic position

Parker (1940) referred *dahliei* to the genus *Cyclorana* Steindachner, a genus that Tyler (1970) and Robinson & Tyler (1973) have shown to exhibit distinct morphological and

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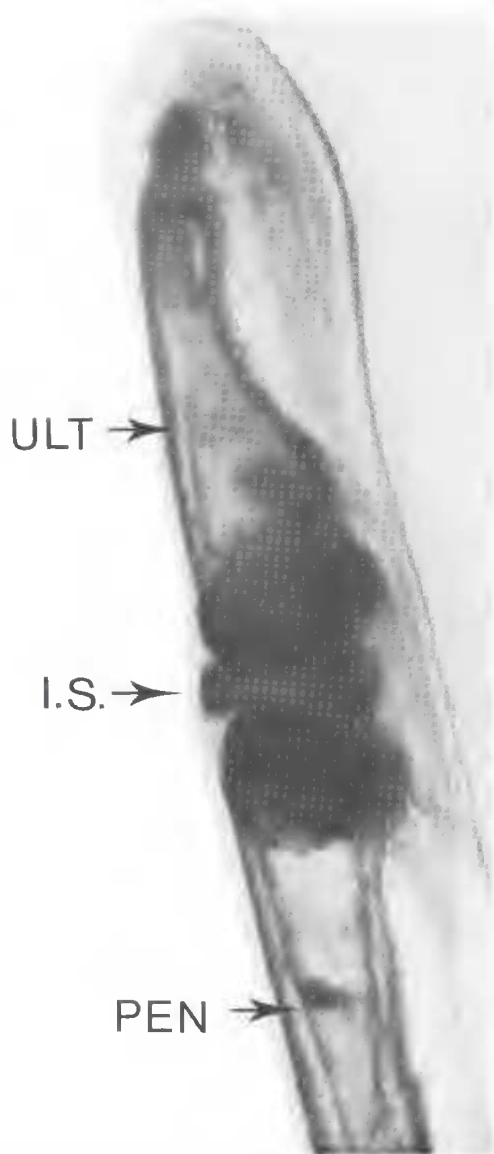


Fig. 1. Enlargement of terminal phalanges of the third toe of a cleared and alizarin stained preparation of *dahlui* showing biconcave, disc-like intercalary structure (x 12.5). Abbreviations: ULT = ultimate (terminal) phalanx; pen = penultimate phalanx; I.S. = intercalary structure.

biochemical affinities with Australopapuan frogs of the family Hylidae. More recently the concept of *Cyclorana* has changed, and with the sole exception of *dahlui*, is composed now exclusively of squat-bodied fossorial species (Tyler 1974; Tyler & Martin 1975, 1977).

Heyer & Liem (1976) omit *Cyclorana* from their study of Australopapuan leptodactylids

(as myobatrachids), from which action it must be concluded that they regard it a member of the Hylidae.

The presence of intercalary structures is currently diagnostic of the Hylidae but not of the Leptodactylidae. Noting the presence of such structures in the species *inermis* (Peters) and *alboguttata* (Gunther), Straughan (1969) and Tyler (1974) referred these species from *Cyclorana* to the hylid genus *Litoria*. In the absence of other characters of significance at the family level we regard any deviation from this recognition likely to result in the Hylidae becoming a heterogeneous assemblage.

Examination of the phalanges of *C. dahlui* reveals ossified intercalary structures forming supernumerary bones (Fig. 1). From the hylid genus *Nyctimystes* this species is further distinguished by its horizontal pupil and absence of a palpebral reticulum. Accordingly we transfer the species to *Litoria* and examine its specific relationships there.

With the removal of *dahlui* from *Cyclorana* the latter genus comprises the following species:

- Cyclorana australis* (Gray)
- Cyclorana brevipes* (Peters)
- Cyclorana cryptotis* Tyler & Martin
- Cyclorana cultripes* Parker
- Cyclorana longipes* Tyler & Martin
- Cyclorana maculosus* Tyler & Martin
- Cyclorana maini* Tyler & Martin
- Cyclorana novaehollandiae* Steindachner
- Cyclorana platycephalus* (Gunther)
- Cyclorana slevini* Loveridge
- Cyclorana verrucosus* Tyler & Martin

Litoria dahlui (Boulenger)

Chiroleptes dahlui Boulenger, 1896, p. 867.

Phractops dahlui: Nieden, 1923, p. 522.

Cyclorana dahlui: Parker, 1940, p. 17.

Material examined: *Northern Territory*—SAM R6448, 15930–34, NTM 1836–64, Beatrice Hill (4); SAM R12338, E. Alligator River; MCZ 25994–5, Knuckey's Lagoon; *Queensland*—R9674–6. Strathgordon H.S.; *Western Australia*—WAM R34601. King River, 15 km S of Wyndham.

External Morphology

The head is moderately high and slightly longer than broad (HL/HW 1.01–1.12), its length equivalent to slightly more than one-third of the snout to vent length. The distance between the eye and the naris is greater than the internarial span (E–N/IN 1.22–1.39). The

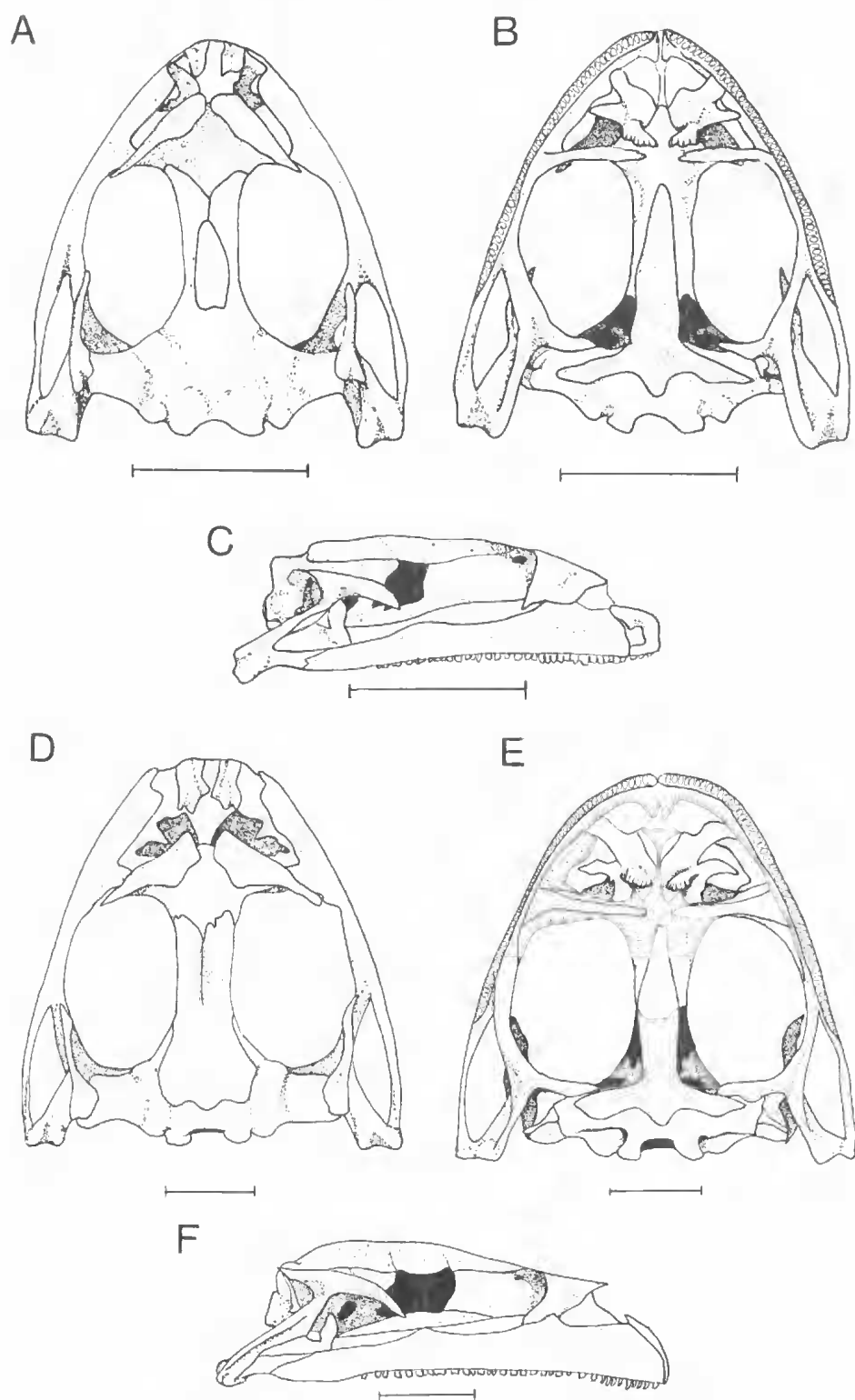


Fig. 2. Osteological preparations of: A-C, *L. dahlui* in dorsal, ventral and lateral view; D-F, *L. raniformis* in dorsal, ventral and lateral view. Scale = 5 mm.

canthus rostralis is straight and scarcely distinguishable. The eye is moderate, its diameter equivalent to approximately the eye to naris distance. The tympanum is large and conspicuous, its diameter almost equal to the eye diameter. The vomerine teeth are on two prominent elevations between and behind the internal choanae. The tongue is broadly oval. The fingers are elongate, lack lateral fringes and the tips are scarcely expanded; in decreasing order of length $3 > 4 > 1 > 2$. The fingers are unwebbed.

The hind limbs are relatively short (TL/S-V 0.45–0.51). Toes in decreasing order of length $4 > 5 = 3 > 2 > 1$. Webbing is extremely extensive, reaching the tips of all digits and separating all of the metatarsals at least partly.

The skin on the dorsal surface is smooth. The throat and chest are smooth and the abdomen and lower thighs very weakly granular. There is no tarsal ridge.

In preservative, specimens are predominantly various shades of slate with irregular darker variegations. A mid-vertebral stripe is commonly present. The back of the thighs are dark slate with a broad, longitudinal creamish stripe or a series of large dots.

In life the animal is similarly a basic slate colour, but there are suffusions of pale green, particularly on the dorso-lateral surfaces.

Cranial Osteology

Material examined: two dried preparations (SAM R6448 and a specimen obtained live from Beaufort Hill); one alizarin preparation of an entire animal also obtained live from Beaufort Hill.

The skull is longer than broad, the slightly elongated snout having a rounded terminal tip in dorsal aspect (Fig. 2). The dorsal surfaces of the skull are smooth and unornamented, there is no ossification or exostosis present, and the skin overlying the skull is freely movable. There is no evidence of prenasal or dermal sphenethmoid bones. Similarly there are no lateral flanges nor occipital crests present.

The nasals are moderately sized and are narrowly separated medially. The maxillary processes of the nasals are sharp and slender and make bony contact with the posterior processes of the pars facialis of the maxillary. They do not extend to the level of the maxillary.

The sphenethmoid is well ossified, with the nasals extending anteriorly beyond its anterior terminus. The frontoparietal fontanelle is large and ovoid.

The orbital margins of the frontoparietals are straight and postero-laterally the frontoparietals do not overlap the crista parotica.

The squamosals are well developed with the zygomatic ramus being long, extending 76% of the distance to the maxilla. The otic ramus is about half the length of the zygomatic ramus. It does not extend for the whole width of the crista parotica, but slightly overlaps the anterior half.

The pterygoid is moderately developed and the medial ramus is in bony contact with the otic capsule. The anterior ramus has an extensive articulation with the maxillary at approximately mid orbit, whilst the posterior ramus is poorly ossified and articulates with the ventral arm of the squamosal. The quadratojugal is well developed and articulates anteriorly with the maxilla and posteriorly with the ventral arm of the squamosal. The parasphenoid lacks odontoid structures and stretches anteriorly almost to the level of the palatines.

The premaxillaries are narrow, toothed structures and are narrowly separated medially. The alary processes are widely separated. Initially they rise perpendicularly to the dentigerous processes of the premaxillaries and then are inclined posteriorly in a hori-

TABLE 1
Cranial features of *Litoria aurea* group

skull shape:	broader than long
nasals:	articulate with and overlap the sphenethmoid which projects anteriorly between, separating them medially (exception: <i>alboguttata</i>)
alary processes of premaxillary:	well developed, inclined posteriorly at angle no less than 45°
pars facialis of maxillary:	moderately deep, posterior process articulates with maxillary process of nasal
quadratojugal:	robust and well developed
squamosal:	well developed, zygomatic ramus longer than otic ramus. Otic ramus overlaps crista parotica
palatine processes of premaxillary:	do not articulate with each other
dentigerous processes of prevomers:	short, inclined at an angle of 45° to midline.

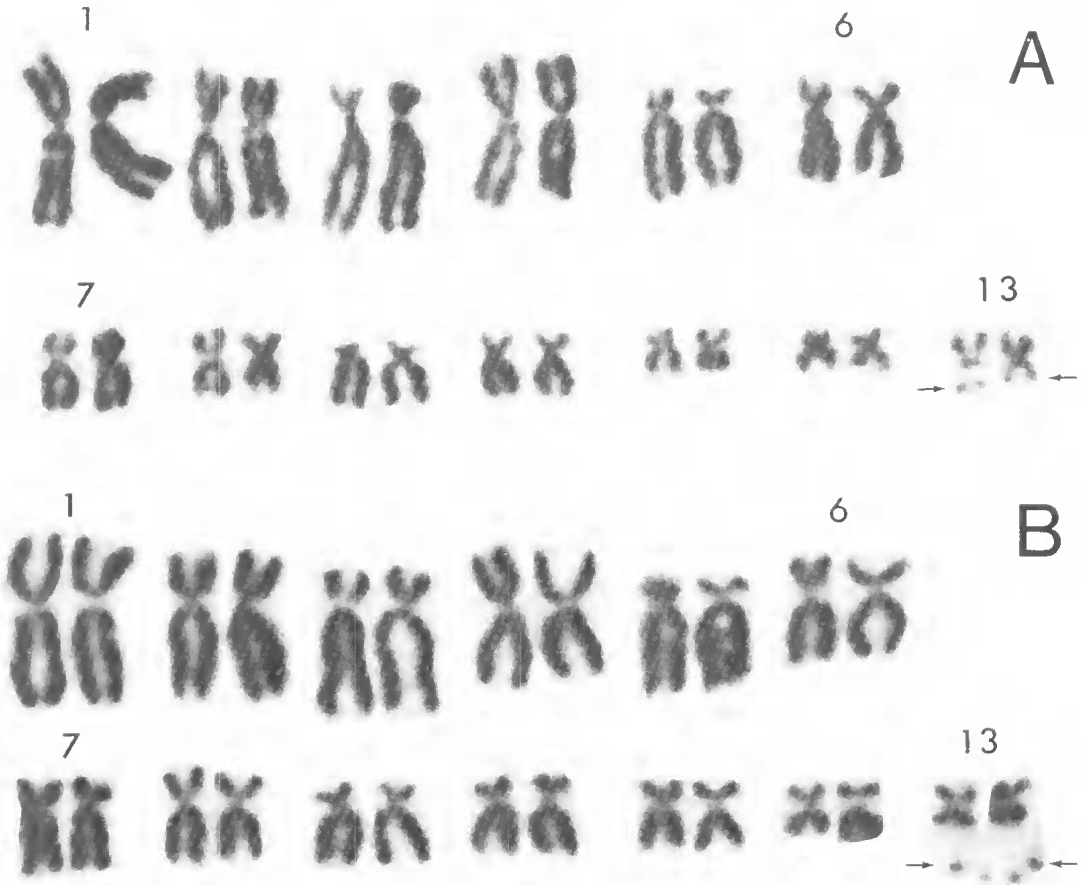


Fig. 3. A—Chromosomes of *L. dahlia* ♂ from Cannon Hill, N.T. B—Chromosomes of *L. raniformis* ♂ from Mil Lel, S.A. Note the characteristic satellites on pair 13 in both species.

zontal plane. The height of the alary processes is almost 1.5 times the height of the dentigerous processes. The palatine processes of the premaxillaries do not articulate with each other. The premaxillaries articulate laterally with the pars palatina and pars dentalis of the maxillary.

The prevomers are narrowly separated medially. They are large, entire and toothed. Postero-laterally, the prevomers bear wings forming the anterior, medial and posterior margins of the choanae. The dentigerous processes are small and moderately separated. They lie perpendicular to the midline and bear 8-10 teeth.

The palatines are narrow slender bones forming the posterior margins of the choanae with the distal ends slightly expanded and lying adjacent to the maxillaries. The palatines do not appear to have postero-ventral shelves.

The maxillary bears a well developed pars facialis, the posterior process of which arti-

culates with the maxillary process of the nasal. The pars palatina is very small, extending ventromedially to the pars dentalis; the maxillary articulates firmly with the quadratojugal at the level of the prootic foramen.

Karyotype Morphology

All specimens of *L. dahlia* and *L. raniformis* analysed had a chromosome number of $2n = 26$. The karyotypes of these species grade from large to small and the chromosomes are metacentric or submetacentric. The centromeres were in the same position in corresponding chromosome pairs in both specimens. A characteristic pair of satellites is present on chromosome pair 13 in both forms (Fig. 3).

Phylogenetic Relationships

In its gross external morphology, resemblance to *Litoria raniformis* and other members of the *Litoria aurea* group (*sensu* Tyler & Davies in press) is quite striking. It shares with the members of that group, moderate to

large size, elongate body form, muscular limbs of moderate length, unwebbed fingers and strongly webbed toes. The single external feature unique to *dahlui* is the degree of webbing of the hind foot, which is particularly extensive in that species.

Osteologically, the cranial features that support its association with the *Litoria aurea* group are listed in Table 1. See also Fig. 2A-F.

Karyotypically, *C. dahlui* and *L. raniformis* have many features in common. Firstly, *C. dahlui* has a chromosome number of $2n = 26$, which is the number most often encountered in the Australian and New Guinea hylids (Morescalchi & Ingram 1974; Menzies & Tippet 1976). In contrast, all known Australian leptodactylid species have $2n = 22$ or $2n = 24$. A number of $2n = 26$ was reported for *Cyclorana alboguttatus* by Morescalchi & Ingram (1974). This finding supports the recent systematic conclusions of Tyler (1974) who referred *C. alboguttatus* to the hylid genus *Litoria*.

Our unpublished data on the chromosomes of 35 species of *Litoria* indicate that many species may be grouped together by using characteristics of their chromosome morphology. *C. dahlui* and *L. raniformis* share the same karyotypic morphology in terms of cen-

tromere position in each chromosome pair. Moreover, *C. dahlui* possesses satellites on pair 13 which are a characteristic of *L. raniformis* and other members of the *L. aurea* group. The possession of this presumably derived condition suggests a close phylogenetic relationship between *C. dahlui* and the *L. aurea* group.

Geographic distribution of the *Litoria aurea* group

Tyler & Davies (in press) illustrated the distribution of the *L. aurea* group which has representatives in southwestern Australia and then in a continual arc from the southeast to the northeast. *Litoria dahlui* now represents the northern and northwestern species so completing a pattern of continuous distribution composed of largely contiguous populations.

Acknowledgments

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References

- BOULENGER, G. A. (1896) Description of a new snake and a new frog from North Australia. *Proc. zool. Soc. Lond.* 1895.
- DAVIES, M. (1978) Variation in the cranial osteology of the Australopapuan hylid frog *Litoria infrafronata*. *Rec. S. Aust. Mus.* 17(22).
- HEYER, W. R. & LIEM, D. S. (1976) Analysis of the intergeneric relationships of the Australian frog family Myobatrachidae *Smithson. Contr. Zool.* (233), 1-29.
- KING, M. & ROFE, R. (1976) Karyotypic variation in the Australian Gekko *Phyllodactylus marmoratus* (Gray) (Gekkonidae: Reptilia). *Chromosoma* 54, 75-87.
- LOVERIDGE, A. (1949) On some reptiles and amphibians from the Northern Territory. *Trans. R. Soc. S. Aust.* 72, 208-215.
- MORESCALCHI, A. & INGRAM, G. J. (1974) New chromosome numbers in Australian Leptodactylidae (Amphibia, Salientia). *Experientia* 30, 1134-5.
- MENZIES, J. I. & TIPPETT, J. (1976) Chromosome numbers of Papuan hylid frogs and the karyotype of *Litoria infrafronata* (Amphibia, Anura, Hylidae). *J. Herpetol.* 10(3), 167-173.
- NIEDEN, F. (1923) Anura 1. In Apstein, C. (Ed.) *Das Tierreich* (46) (de Gruyter: Berlin).
- PARKER, F. & TANNER, C. (1971) Some frogs from Southern Cape York Peninsula. *N. Qld Nat.* 39(155), 4-8.
- PARKER, H. W. (1940) The Australasian frogs of the family Leptodactylidae. *Novit. zool.* 42(1), 1-106.
- ROBINSON, R. L. & TYLER, M. J. (1972) The catecholamine content of the adrenal glands of frogs as an index of phylogenetic relationship. *Comp. Gen. Pharmacol.* 3(10), 167-170.
- STRAUGHAN, I. R. (1969) *Hyla inermis* (Peters), a species hitherto erroneously referred to the leptodactylid genus *Cyclorana* (Anura, Hylidae/Leptodactylidae). *Zoöl. Meded.* 43(17), 207-212.
- TYLER, M. J. (1968) Papuan hylid frogs of the genus *Hyla*. *Zool. Verh., Leiden* (96), 1-203.
- TYLER, M. J. (1969) A synopsis of the frogs of the genus *Hyla* of north-western Australia, with the description of a new species. *Rec. S. Aust. Mus.* 16(1), 1-11.
- TYLER, M. J. (1970) Patterns of distribution and the origins of the Papuan hylid frog fauna. *Search* 1(5), 246-247.

- TYLER, M. J. (1974) The systematic position and geographic distribution of the Australian frog *Chiroleptes alboguttatus* Gunther. *Proc. R. Soc. Qld* **85**(2), 27-32.
- TYLER, M. J. & DAVIES, M. (in press) Species groups within the Australopapuan hylid frog genus *Litoria* Tschudi. *Aust. J. Zool.*, suppl. (63).
- TYLER, M. J. & MARTIN, A. A. (1975) Australian frogs of the *Cyclorana australis* complex. *Trans. R. Soc. S. Aust.* **99**(2), 93-99.
- TYLER, M. J. & MARTIN, A. A. (1977) Taxonomic studies of some Australian leptodactylid frogs of the genus *Cyclorana* Steindachner. *Rec. S. Aust. Mus.* **17**(15), 261-276.

STRATIGRAPHY OF THE LOWER WILPENA GROUP (LATE PRECAMBRIAN), FLINDERS RANGES, SOUTH AUSTRALIA

BY P. S. PLUMMER

Summary

A revised nomenclature is proposed for the dominantly clastic sequence of sediments comprising the lower Wilpena Group (late Adelaidean) within the Adelaide fold belt. This sequence, herein termed the Brachina Subgroup, has sharp, locally disconformable lower and upper boundaries, between which formations are defined on the basis of mappable lithozones.